18. Find finite Fourier sine and cosine transforms of the function $f(x) = x^2$ for $0 < x < 4$.

19. (a) Discuss the steps to be followed for the construction of a character table.

    (b) Construct the character table for C_{3v}.

20. Define Binomial distribution. Show that the mean and variance of Binomial distribution are np and npq respectively.

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NOVEMBER/DECEMBER 2024

DPH21/GPH21 — MATHEMATICAL PHYSICS - II

Time : Three hours Maximum : 75 marks

SECTION A — (10 × 2 = 20 marks)

Answer ALL questions.

1. State Residue theorem.

2. Check whether $\sin z$ analytic.

3. Write Laplace equation in spherical polar coordinates.

4. If $V = 3x^2 + 2x$, find $\frac{\partial v}{\partial x}$.

5. State the linearity property of Fourier integral transform.

6. Find the Laplace transform of $\sin at$.

7. What is a point group? Give examples.

8. Define homomorphism.

9. Write the moment generating function of normal distribution.

10. State Laplace – de Moivre limit theorem.

SECTION B — (5 × 5 = 25 marks)

Answer ALL questions.

11. (a) Evaluate $f(z) = \frac{1}{(z-1)(z-2)}$ between the annular region $z = 1$ and $z = 2$.

Or

(b) State and prove Taylor series.

12. (a) Obtain the solution of the two dimensional diffusion equation.

Or

(b) Obtain the solution of 2D Laplace equation in Cartesian coordinates.

13. (a) Find the Fourier transform of $e^{|t|}$.

Or

(b) Find the Laplace transform of $\frac{1}{t} f(t)$.

14. (a) Show that the group of order 2 and 3 are always cyclic.

Or

(b) Prove that the two dimensional representation of matrices $C_4, T(E) = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ $T(A) = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}, T(A^2) = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$ and $T(A^3) = \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$ is reducible.

15. (a) Find the expectation of a discrete random variable X whose probability function is given by $f(x) = \left(\frac{1}{2}\right)^x$ where $x = (1, 2, 3, 4, ...)$.

Or

(b) Determine the probability of throwing more than 8 with 3 perfectly symmetrical dice.

SECTION C — (3 × 10 = 30 marks)

Answer any THREE questions.

16. Derive Cauchy's integral formula.

17. Deduce the equation of motion of a string assuming that the string vibrates only in a vertical plane.